

What is claimed is:

1. A vein reinforcement device to reduce increased vascular resistance of a vein when exposed to externally applied forces, the device including a reinforcement structure arranged to
5 continuously overlie, in adjacent relation to, a wall of a vein, the reinforcement structure having a longitudinal dimension and a cross-sectional dimension defining an area, the longitudinal dimension being greater than the cross-sectional dimension, the reinforcement structure being longitudinally flexible and cross-
10 sectionally resistant to area change.
2. The device of claim 1 wherein the cross-sectional dimension is substantially circular.
- 15 3. The device of claim 1 wherein the reinforcement structure is formed of a metal.
4. The device of claim 3 wherein the reinforcement structure is formed of one of stainless steel and Nitinol.
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5. The device of claim 3 wherein the reinforcement structure is formed of a wire structure.
6. The device of claim 5 wherein the reinforcement structure
25 further includes an external coating overlying the wire structure.
7. The device of claim 6 wherein the external coating is formed of one of silicone rubber and Teflon.

8. The device of claim 1 wherein the cross-sectional dimension configures the reinforcement structure for overlying the vein wall externally to the vein.

5 9. The device of claim 1 wherein the cross-sectional dimension configures the reinforcement structure for overlying the vein wall within the vein.

10 10. The device of claim 9 wherein the reinforcement structure is an expandable structure.

11. The device of claim 1 wherein the reinforcement structure is only cross-sectionally resistant to area change for applied forces less than about 50 mm Hg.

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12. A renal vein reinforcement device comprising a reinforcement structure of substantially cylindrical configuration, the reinforcement structure arranged to continuously overlie, in adjacent relation to, an inner wall of a renal vein, having a flexible longitudinal dimension and a cross-sectional dimension resistant to reduction in the presence of applied external forces to the renal vein to reduce increased vascular resistance.

25 13. The device of claim 12 wherein the reinforcement structure is formed of a metal.

14. The device of claim 13 wherein the reinforcement structure is formed of one of stainless steel and Nitinol.

15. The device of claim 13 wherein the reinforcement structure is formed of a wire structure.

5 16. The device of claim 15 wherein the reinforcement structure further includes an external coating overlying the wire structure.

10 17. The device of claim 16 wherein the external coating is formed of one of silicone rubber and Teflon.

15 18. The device of claim 12 wherein the reinforcement structure is an expandable structure to permit the reinforcement structure to be positioned within the renal vein in a collapsed state and thereafter expanded to the substantially cylindrical configuration.

20 19. The device of claim 12 wherein the reinforcement structure has a longitudinal center axis and wherein the cross-sectional dimension is only resistant to reduction in the presence of applied radial pressure of less than about 50 mm Hg.

25 20. A vein reinforcement device, the device including reinforcement structure means for lining and reinforcing a wall of the vein, the reinforcement structure means having a longitudinal dimension and a cross-sectional dimension, the longitudinal dimension being greater than the cross-sectional dimension, the longitudinal dimension being flexible and the cross-sectional

dimension being resistant to change in the presence of external forces applied to the vein.

21. The device of claim 20 wherein the cross-sectional
5 dimension is substantially circular.

22. The device of claim 20 wherein the reinforcement structure means is formed of a metal.

10 23. The device of claim 22 wherein the reinforcement structure means is formed of one of stainless steel and Nitinol.

24. The device of claim 22 wherein the reinforcement structure means is formed of a wire structure.

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25. The device of claim 24 wherein the reinforcement structure means further includes an external coating overlying the wire structure.

20 26. The device of claim 25 wherein the external coating is formed of one of silicone rubber and Teflon.

27. The device of claim 20 wherein the cross-sectional dimension configures the reinforcement structure means for lining
25 an external wall of the vein.

28. The device of claim 20 wherein the cross-sectional dimension configures the reinforcement structure means for lining an inner wall of the vein.

29. The device of claim 26 wherein the reinforcement structure means is expandable from a collapsed condition to a deployed expanded condition.

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30. The device of claim 20 wherein the reinforcement structure means has a longitudinal center axis and wherein the cross-sectional dimension is only resistant to reduction in the presence of forces of less than about 50 mm Hg.

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31. A method of reducing increased vascular pressure in a vein in the presence of forces applied external to the vein, the method including the steps of:

15 providing a reinforcement structure arranged to continuously overlie, and adjacent relation to, a wall of a vein, the reinforcement structure having a longitudinal dimension and a cross-sectional dimension, the longitudinal dimension being greater than the cross-sectional dimension, the reinforcement structure being longitudinally flexible and
20 cross-sectionally resistant to area change; and
overlying the wall of the vein with the reinforcement structure.

32. The method of claim 31 wherein the overlying step
25 includes the step of overlying an outer wall of the vein with the reinforcement structure.

33. The method of claim 31 wherein the overlying step includes the step of overlying an inner wall of the vein with the reinforcement structure.

5 34. The method of claim 33 further including the step of guiding the reinforcement structure into position within the vein through a catheter.

10 35. The method of claim 33 wherein the reinforcement structure is initially in a collapsed state and expandable to a deployed state and wherein the method further includes the steps of positioning the reinforcement structure within the vein while the reinforcement structure is in the collapsed state and thereafter expanding the reinforcement structure to the deployed
15 state.

20 36. The method of claim 35 wherein the expanding step includes the step of expanding the reinforcement structure with a balloon.

25 37. The method of claim 35 further including the steps of feeding a catheter having a distal end into the vein until the distal end is at a desired position within the vein and thereafter, advancing the reinforcement structure through the catheter to the desired position.

38. A method of reducing increased vascular pressure in a renal vein in the presence of forces applied external to the renal vein, the method including the steps of:

providing a reinforcement device arranged to continuously overlie, in adjacent relation to, an inner wall of the renal vein, the device having a flexible longitudinal dimension and a relatively rigid cross-sectional dimension resistant to reduction in the presence of applied external forces to the renal vein; and

overlying the wall of the renal vein with the reinforcement device.

39. The method of claim 38 wherein the overlying step includes the step of overlying an outer wall of the renal vein with the reinforcement device.

40. The method of claim 38 wherein the overlie step includes the step of overlying an inner wall of the renal vein with the reinforcement device.

41. The method of claim 40 further including the step of guiding the reinforcement device into position through a catheter.

42. The method of claim 40 wherein the reinforcement device is initially in a collapsed state and expandable to a deployed state and wherein the method further includes the steps of positioning the reinforcement device within the renal vein while the reinforcement device is in the collapsed state and thereafter expanding the reinforcement device to the deployed state.

43. The method of claim 42 wherein the expanding step includes the step of expanding the reinforcement device with a balloon.

5 44. The method of claim 42 further including the steps of feeding a catheter having a distal end into the vein until the distal end is at a desired position within the vein and thereafter, advancing the reinforcement device through the catheter to the desired position.

10 45. The method of claim 38 wherein the renal vein is the left renal vein and wherein the overlying steps includes the step of overlying the wall of the renal vein with the reinforcement device at a desired position where the left renal vein crosses the
15 aorta.

46. The method of claim 45 wherein the overlying step includes the step of overlying an inner wall of the left renal vein with the reinforcement device.

20 47. The method of claim 46 further including the step of guiding the reinforcement device to the desired position through a catheter.

25 48. The method of claim 46 wherein the reinforcement device is initially in a collapsed state and expandable to a deployed state and wherein the method further includes the steps of positioning the reinforcement device within the left renal vein while the reinforcement device is in the collapsed state and

thereafter expanding the reinforcement device to the deployed state.

49. The method of claim 48 wherein the expanding step
5 includes the step of expanding the reinforcement device with a balloon.

50. The method of claim 48 further including the steps of
feeding a catheter having a distal end into the left renal vein
10 until the distal end is at the desired position within the left renal vein and thereafter, advancing the reinforcement device through the catheter to the desired position.

51. A method of treating preeclampsia, the method including
15 the steps of:
providing a vascular reinforcement device; and
placing the vascular reinforcing device adjacent to a wall of the left renal vein in a position which overlies the aorta.

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52. The method of claim 51 wherein the placing step includes implanting the vascular reinforcement device within the left renal vein.

25 53. The method of claim 52 wherein the implanting step includes the step of guiding the vascular reinforcement device into position with the left renal vein through a catheter.

54. The method of claim 52 wherein the vascular reinforcement device is initially in a collapsed state and expandable to a deployed state and wherein the method further includes the steps of positioning the vascular reinforcement device within the vein while the vascular reinforcement device is in the collapsed state and thereafter expanding the vascular reinforcement device to the deployed state.

55. The method of claim 54 wherein the expanding step includes the step of expanding the vascular reinforcement device with a balloon.

56. The method of claim 54 further including the steps of feeding a catheter having a distal end into the left renal vein and advancing the vascular reinforcement device, while in the collapsed state, through the catheter into position within the left renal vein.

57. A method of treating hypertension associated with obesity, the method including the steps of:
providing a vascular reinforcement device; and
placing the vascular reinforcing device adjacent to a wall of the left renal vein in a position which overlies the aorta.

58. The method of claim 57 wherein the placing step includes implanting the vascular reinforcement device within the left renal vein.

59. The method of claim 58 wherein the implanting step includes the step of guiding the vascular reinforcement device into position within the left renal vein through a catheter.

5 60. The method of claim 58 wherein the vascular reinforcement device is initially in a collapsed state and expandable to a deployed state and wherein the method further includes the steps of positioning the vascular reinforcement device within the vein while the vascular reinforcement device is
10 in the collapsed state and thereafter expanding the vascular reinforcement device to the deployed state.

61. The method of claim 60 wherein the expanding step includes the step of expanding the vascular reinforcement device
15 with a balloon.

62. The method of claim 60 further including the steps of feeding a catheter having a distal end into the left renal vein and advancing the vascular reinforcement device, while in the
20 collapsed state, through the catheter into position within the left renal vein.

63. The device of claim 1 wherein the reinforcement structure includes a midsection and a pair of end sections and
25 wherein the midsection is configured to provide a greater resistance to cross-sectional area change than the end sections.

64. The device of claim 63 wherein the reinforcement structure is a wire structure.

65. The device of claim 64 wherein the wire structure includes heavier wire stock in the midsection than in the end sections.